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## Published

*With international search report.*

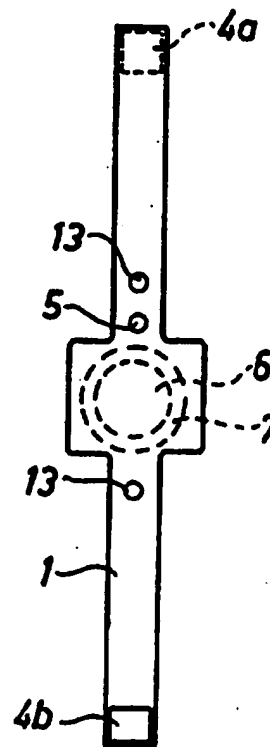
*Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

*In English translation (filed in Swedish).*

(54) Title: A METHOD OF MEASURING THE TEMPERATURE OF HUMANS AND ANIMALS

## (57) Abstract

The invention concerns a method of measuring the body temperature. The measurement is performed by application of an electronic temperature sensor (5) to the skin, preferably on a foot (2) of the individual or animal concerned. The measurement results from the temperature sensor (5) are transferred by a wireless transmission to a receiver (8) via a transmitter (6). The receiver is provided with a display (9) for display of the measurement results, and with alarms (10, 11) to indicate measurement values outside a predetermined temperature range.



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A METHOD OF MEASURING THE TEMPERATURE OF HUMANS AND  
ANIMALS

The present invention relates to a method of measuring the temperature of humans and animals.

As is generally known, the body temperature of humans is measured, when required from time to time, orally or rectally. However, under certain circumstances there is a need for a more continuous monitoring of the body temperature and changes thereof, particularly in babies and infants. In this respect, three different situations are worth mentioning. The first one relates to dressed babies (up to one year old) which are exposed to a chilly environment while sleeping. The second situation relates to children under the influence of anaesthetic or children generally under the influence of sedatives or pain killing drugs or that suffer from some serious disease. The third situation relates to children suffering from a serious brain damage.

For research purposes, measurement of the body temperature has been carried out on children in all three situations defined above. The results from the first situation show that a naked child, when asleep, wakes easily when exposed to cold. The child tolerates only a slight decrease in the temperature of the skin and an increase of about 50% of the basic heat losses, before waking up. For the purpose of evaluating the importance of clothing to babies, measurement has been effected with respect to 20 dressed children in an environment of moderately lowered temperature (13-17°C). It has been found that despite the lowered skin temperature and a considerable increase of the basal energy losses (250-400%), more than half the number of children were asleep when the measuring was concluded after about one hour. Remarkably, it was found that only the most peripheral

parts of the limbs responded quickly by significantly lowering the skin temperature when experiencing considerable heat losses. Previous studies have shown that in this situation children are only able to  
5 compensate for heat losses of a maximum of 200%, which thus is significantly less than the measured losses.

The reason why clothed children continue to sleep despite considerable heat losses has been thought to be a consequence of the micro-climate existing between the  
10 skin of the child and the clothes changing too slowly to stimulate the temperature receptors of the skin to a sufficient degree to cause the child to wake up. The considerable heat losses, vastly exceeding the generation of heat, expose the children to the risk that the core  
15 temperature of the body drops rapidly. Infants that are asleep e.g. outdoors in a pram for several hours or are outdoors in the winter in cold and snowy conditions, run the risk of finding themselves in potentially dangerous temperature situations. Under these circumstances,  
20 continuous monitoring of the skin temperature of e.g. the foot of the child could be of great value. It would allow the parents of the child to become aware at an early stage that the temperature is declining to an unfavourable level.

25 In the second situation, i.e. in the case of children under the influence of anaesthetic following e.g. an operation, the temperature regulating system of the child does not function. During the operation proper, the temperature may be monitored satisfactorily by  
30 continuously monitoring the body temperature rectally. Nonetheless, also these children will benefit from skin temperature monitoring, since impaired circulation caused by large blood losses or too superficial narcosis directly affect the circulation of the blood in the skin  
35 and thus the skin temperature of the child.

Also during the subsequent treatment period in a post-operative and intensive-care ward when the child's

own temperature control system is again functioning but the ability of the child to sense and react to temperature deviations is limited because of the previous anaesthetization, skin temperature monitoring is of great value for three reasons. In the first place, the skin temperature heralds incipient temperature deviations at an earlier stage than does the deep body temperature, and in the second place, during the post-operative stage, there is a risk for continued bleeding and for pain that may indirectly manifest itself as a drop in the skin temperature. In the third place, skin temperature monitoring often makes it possible to avoid the irritation that rectal temperature measurement causes, particularly in somewhat older children.

Also in the third situation, viz. children suffering from a severe brain damage produced e.g. in connection with a difficult child-birth with resulting asphyxia skin temperature monitoring may be extremely important, since in such situations the system controlling the body core temperature often is partly out of order. Children thus afflicted exhibit a rapidly fluctuating body temperature. The condition causes great anguish and makes the care by hospital staff and parents very difficult. In addition, the circumstances often prolong the period of initial care of the child in the neonate ward and also may make additional hospitalization necessary later on.

The present invention provides a method allowing simple yet at the same time reliable monitoring of the temperature of primarily unclothed and clothed children but obviously also of grown-ups and animals. The characterizing features appear from the appended claim 1.

The invention will be described in more detail in the following with reference to the accompanying drawings, wherein:

Fig. 1 is a schematic representation of a device for implementation of the method in accordance with the invention, and

Fig. 2 is a situation view of a child equipped with the claimed device.

The device comprises the following basic components. An attachment member, e.g. a strip 1, is intended to be wound around e.g. one of the feet 2 of the baby 3. At its ends, the strip 1 is formed with fastening means 4a, 4b which may be in the form of a buckle or, as indicated in Fig. 1, a Velcro tape type of fastener. The strip 1 supports a temperature sensor 5 which is in contact with the skin, preferably with the sole of the foot 2 of the child 3, and a transmitter 6 connected to the temperature sensor 5. A battery 7 supplies the electric energy and allows the temperature sensor 5 to emit electrical signals corresponding to registered skin temperature values to the transmitter 6, the latter in turn arranged to emit wireless signals to the receiver 8 positioned at a distance from the transmitter 6. The receiver is fitted with equipment already known per se and thus not illustrated for transformation of the signals received from the emitter, and also with a display 9 for digital display of the registered temperature values.

In accordance with the embodiment shown in the drawing figures the receiver 8 is also equipped with alarms in the form of a warning lamp 10 and a buzzer 11 arranged to emit a light signal, such as an intermittent red light and a sound signal, respectively, to attract the attention of the person or persons concerned if or when the temperature sensor 5 registers a temperature outside the acceptable temperature range. By means of a button 12 the display may be shifted from showing the temperature in degrees Centigrade to degrees Fahrenheit, and vice versa.

The most important advantage of the method in accordance with the invention resides in the temperature being sensed by the temperature sensor 5 in direct contact with the skin, preferably a limb, and most preferably in contact with the sole of the foot. The

reason is that it has been found out that monitoring of the skin temperature of the foot provides the earliest indication of incipient temperature deviations from the normal body temperature. This is true as regards  
5 unclothed as well as clothed children.

The method is advantageous also because of the wireless transmission of the measurement results to the receiver 8. This solution also obviates the practical problem of having to draw leads through the clothes from  
10 the temperature sensor 5 to the receiver 8.

One example of the usefulness of the invention in practice is that e.g. a mother may let her child sleep out of doors in a pram with the inventive device applied around one foot while she herself is occupied indoors,  
15 without having to frequently check the child for preventive purposes. Instead, the device in accordance with the invention informs the mother, should the measurement results indicate a drop in the child's body temperature, by activating the alarms 10, 11 of the  
20 receiver 8, to alert the mother to the fact that the child may be uncovered and consequently his becoming cold. The device may also be of life-saving importance when a rise or a drop in the body temperature is a sign of a condition of illness that need to be dealt with  
25 immediate attention.

The measurement results need not be transmitted to the receiver 8 in a continuous flow. Instead, prior-art electronics technology may be used to activate and inactivate the emitter 6 at predetermined intervals.

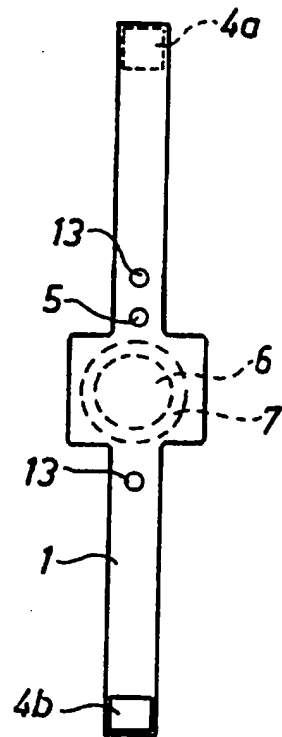
30 To save the energy of the battery 7 the electronic circuit disposed in the strip 1 may include a couple of electrodes 13. The electrodes may be of a kind which closes the circuit upon their first contact with the skin as the strip is being applied on a part of the body.  
35 Owing to this arrangement the device assumes an active state only when in its sensing position. Also, the receiver 8 may normally be in an inactive state in order

to save energy and be arranged to react only when the emitter 6 transmits signals.

The invention is not limited to the embodiment shown and illustrated but may be varied in many ways within the scope of the appended claims. This is true both of the attachment member 1 which could be constructed otherwise than shown and for instance be formed with other kinds of switches than the electrodes 13, and of the receiver 8, which could have another type of sound-emitting means than a buzzer 11 and for instance be fitted with a display 9 emitting an intermittent light as soon as a sensed temperature is found to deviate more than is acceptable.

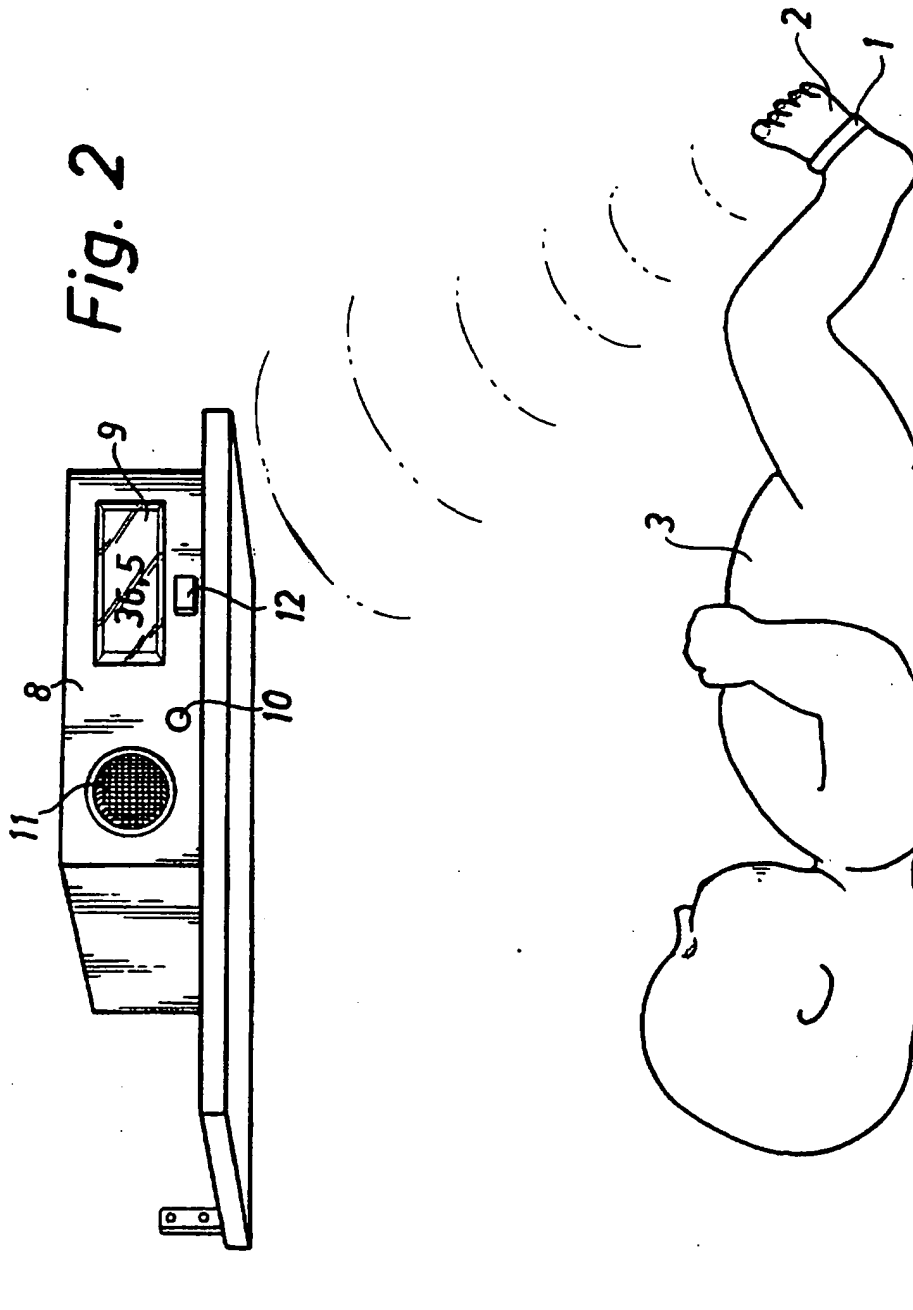


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*Fig. 1*

2/2

Fig. 2



# INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE 97/00279

## A. CLASSIFICATION OF SUBJECT MATTER

IPC6: G01K 1/02, G01K 13/00

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: G01K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	US 4471354 A (R.B. SMITH), 11 Sept 1984 (11.09.84), see whole document --	1-2
X	US 4747413 A (H.S. BLOCH), 31 May 1988 (31.05.88), see whole document --	1-2
X	US 5033864 A (M.R. LASECKI ET AL), 23 July 1991 (23.07.91), see whole document --	1-2

☒ Further documents are listed in the continuation of Box C.

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## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

03/06/97

International application No.

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Information on patent family members

International application No.  
**PCT/SE 97/00271**

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